

CT Competencies

Developing guidance for the appropriate use of computed tomography within a hybrid imaging environment.

The introduction of computed tomography (CT) within the nuclear medicine environment over the last decade has led to a dramatic increase in the number of hybrid imaging installations within the United Kingdom¹. Modern multislice single photon emission computed tomography (SPECT) and positron emission tomography (PET)/CT units now have the diagnostic capability to provide a high level of anatomical information² and have redefined the physical environment required for this imaging modality³. This, alongside current financial pressures impacting on the NHS, has begun to challenge traditional working practices and an increased emphasis is now being placed on the healthcare practitioner to provide high quality care, demonstrate greater clinical effectiveness, improve safe working practices and to continuously adapt their skills to meet with the changing needs of the patient⁴.

Initial research conducted by the authors, in collaboration with existing clinical nuclear medicine practitioners⁵ has indicated variation in the optimal use of CT within a hybrid imaging environment. It is a concern that this apparent position within the hybrid imaging community does not appear to be conducive with current

government initiatives related to optimal service provision⁶. These inconsistencies would, therefore, appear to highlight the need for the development of a competency-based framework, that would provide the practitioner with the opportunity to develop their own working practices and help promote the harmonised use of CT within the hybrid imaging environment.

Background

The introduction of new hybrid imaging systems and the emergence of new clinical procedures/techniques⁷ has created opportunities for the nuclear medicine practitioner to develop and harness new skills and knowledge⁸. Introducing new technology and techniques within an established clinical environment can impact upon workforce dynamics and efficiency rates⁹, and therefore the need to develop appropriate guidance for those healthcare practitioners employed within the hybrid imaging environment would seem of paramount importance. If this position is not achieved, the hybrid imaging

modality risks not complying with current government initiatives associated with patient centred care, service efficiency and the upskilling of the workforce¹⁰.

The impact of CT within a hybrid imaging environment has changed all elements of the nuclear medicine procedure and additional awareness needs to be demonstrated by the nuclear medicine practitioner. Figure 1 highlights the various steps that are encountered within a typical hybrid imaging examination¹¹, and whilst the CT element does not appear at the beginning of the examination, it must be considered throughout. Without this appropriate planning the potential success of the whole procedure could be compromised and an additional radiation burden could be placed upon the patient.

Consideration as to the importance of organisational workflow and the adaptation of new skills following the introduction of new technology, has been studied extensively by Barley¹² and Schoenhofer and Boykin¹³. Both studies link to



Figure 1: Typical steps involved in the completion of a SPECT/CT examination.

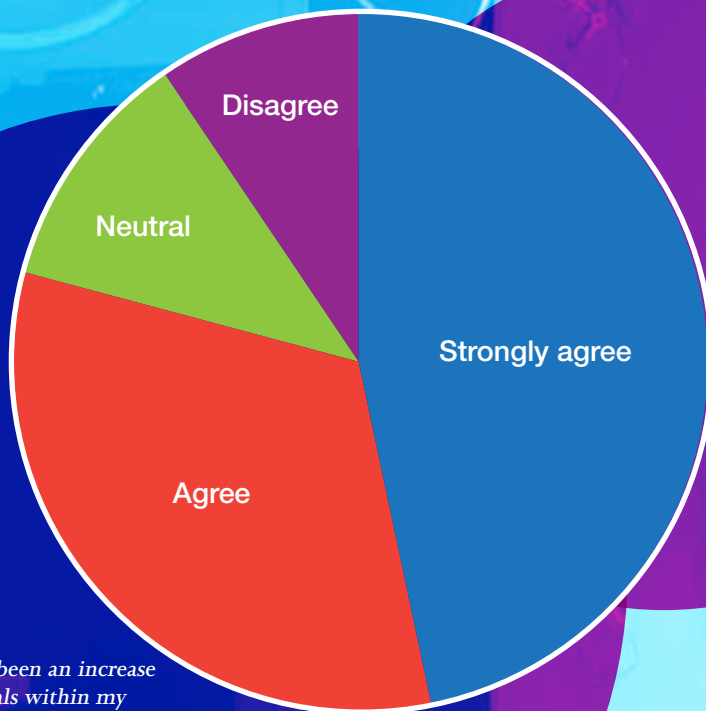


Figure 2: There has been an increase in SPECT/CT referrals within my clinical department⁵.

the necessity for the continuous reframing of service provision and for the development of new practitioner knowledge and skills, in order to optimise performance and ultimately enhance patient outcomes. Given the position stated above, the need to develop appropriate guidelines related to the optimal use of CT within a hybrid imaging environment would seem necessary. This position resonates with previous work conducted by Larsson et al¹⁴ and Williams and Berry¹⁵ who identified the need for training competencies, following the introduction of new technology and techniques within a clinical radiography environment.

Evidence to support the development of CT competencies

In order to ensure the appropriateness of this guidance for the nuclear medicine workforce, evidence from a national conference was gathered⁵. Importantly, these findings were generated from a dedicated 'technologist' session at the conference and it is thought that the results represent the views of the imaging practitioners who are most commonly using these new hybrid imaging technologies, ie clinical

technologists and radiographers.

Figure 2 supports published evidence related to the increasing use of CT within a hybrid imaging environment¹ and was achieved by asking delegates who attended the conference whether SPECT/CT referrals have increased in their clinical departments. The results from figure 2 would appear to further validate the development of a competency-based framework as an increase in SPECT/CT referrals may require existing clinical protocols to be developed⁸ and the need to equip the practitioner with the skills to adapt to these changes would seem fundamental to the continuation of a high quality imaging service.

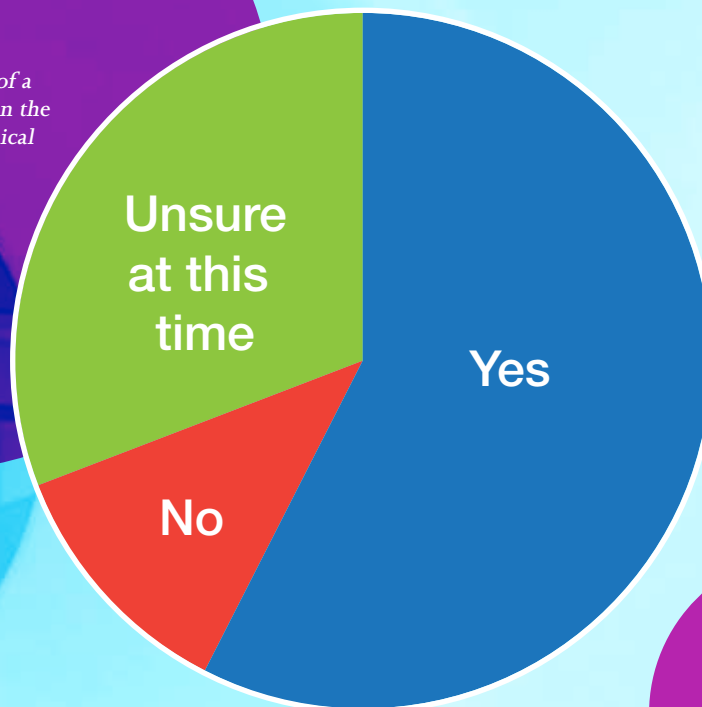
Nuclear medicine practice is witnessing a transformational change in terms of the evolving technological developments¹⁰. Hybrid imaging systems are now common place within most nuclear medicine departments and with this comes the creation of new patient workflows and opportunity for role development¹¹. However despite this transformational change, there remains the risk that the principles of this new imaging technology may not be 'diffused' adequately across the workforce, leading to potential issues associated with uncertainty, fear

and possible resistance to change.

An example of this can be highlighted if we consider the introduction of new 'physical barriers' such as the CT control console with a lead glass screen and an intercom, which is reshaping the way in which the nuclear medicine practitioner is able to interact with their patient during the CT element of the hybrid imaging examination. Careful consideration is needed for patients that require additional support during certain hybrid imaging examinations and the nuclear medicine practitioner should not rely purely upon the use of technology (ie CCTV, intercoms) to provide care. Indeed, there is a greater need for the development of patient centred skills, with nuclear medicine practitioners becoming more central in the imaging and treatment pathway. Being able to promote such new ways of working will require additional training and the use of a CT competency framework will help in such a transitional process.

In order to address some of these potential issues, the innovation, diffusion and adoption of new technologies have become integral aspects of the modern NHS^{16,17,18}, and the need to ensure the current and future nuclear medicine

Figure 3: Would the introduction of a CT competency framework assist in the ongoing development of your clinical services and workforce?²⁵



workforce is appropriately skilled, in line with national training mandates¹⁸ remains of significant importance.

Current UK-based guidance associated with the use of CT within the hybrid imaging environment appears to be limited, with many departments gravitating towards international-based guidelines^{19, 20}. The Society and College of Radiographers (SCoR)²¹ has produced an overview document that provides useful information for practitioners working at different professional levels within a hybrid imaging environment. However, this document does not provide specific guidance associated with the appropriate use of CT within a hybrid imaging environment.

This lack of specific guidance is perhaps further reinforced if the findings of figure 3 are considered with a large proportion of the respondents highlighting the benefits that the production of appropriate CT-based guidance would bring to the imaging environment.

A further interesting point highlighted by figure 3, is the notion that 30% of respondents were unsure whether the use of a CT competencies framework would provide stability and

certainty (with reference to hybrid imaging) in future clinical practice. Early adopters of new technology should ensure that an understanding of its use is diffused throughout the environment where it may be employed⁹, and that greater overall understanding for the practitioner should be coupled with an evidence-based approach to developing techniques²². Cultural lag however, may prevent this in some instances and could explain why 30% of the respondents in figure 3 were unsure of the value of introducing CT competencies. Cultural lag is defined where the cultural adaptations, beliefs and values within an organisation fail to change at the same speed as the technology that has been introduced²³. Cultural lag may be experienced at different time points, prior to, or after the introduction of new technology and can be contributed to factors such as a lack of formal training and role assessment²⁴.

From the points previously outlined, there would appear to be clear evidence to support the fact that the introduction of CT within the nuclear medicine environment will promote a number of role development opportunities and as such this factor needs to be considered in

the creation of these CT-based competencies. While important, the overarching aim of such a document should not only be to equip the nuclear medicine practitioner with the necessary skills needed to optimise imaging technique, but should also consider the wider importance and utilisation of this developing area of clinical practice. For example, there are excellent skill mix opportunities within a hybrid imaging environment, with nuclear medicine practitioners working inter-professionally with cardiology practitioners and radiotherapy radiographers. The use of SPECT/CT to provide tumour staging information is documented²⁵ and as a means of reducing the need for unnecessary invasive surgery¹.

Providing appropriate guidance on the effective use of CT within a multi-professional working environment, helps to promote the role of, the nuclear medicine practitioner, raise awareness of the modality and assists staff in further understanding of the capabilities of modern hybrid imaging systems within current and future patient care pathways. Importantly, the positioning of the nuclear medicine practitioner within the hybrid imaging environment continues

to develop and the creation of a professional identity, with emerging roles and responsibilities, would seem apparent.

Design, development of the CT competencies and initial feedback

Following a review of the information and opinions collected from a regional hybrid imaging event²⁶ and national conferences^{27,5} the authors, working in conjunction with a number of NHS Trusts have developed a draft CT competencies document, which is now available for assessment and possible implementation within the nuclear medicine environment. This draft document has been reviewed and trialled by several clinical nuclear medicine departments within the United Kingdom.

Development of the initial draft of the CT competencies involved the author(s) ensuring their own understanding of the potential uses of CT within the hybrid imaging environment. This involved attending a number of regional and national conferences and workforce development events. Once a consensus of understanding had been achieved, reference to international nuclear medicine practice was also explored. Of particular interest was the approach adopted in North America²⁸, by technologists requiring the use of CT within a hybrid imaging environment; there appears to be a distinct lack of national-based guidance around the use of CT within a hybrid imaging environment in the USA.

The initial draft of CT competencies covered a number of core areas including:

- Rationale and background for the development of the CT competencies document;
- Pre-learning and evaluation of service development requirements within the practitioner's own clinical department;
- Activities for the practitioner to complete throughout the CT competencies document;
- Guidance for completion of CT competencies to help the practitioner, mentor and departmental manager;
- Logbook of clinical experience

to record clinical experience and document evidence for audit purposes;

- Basic quality control checks performed within a hybrid imaging environment.

The practitioner was initially set a suggested minimum target of 100 hybrid examinations to achieve, as part evidence of completing the CT competencies framework. However after consultation with a number of clinical managers, this figure was reduced to reflect the fact that some departments may only desire to use their CT component at a 'low dose' level performing areas, such as attenuation, correction and localisation.

The number of categories within the CT competency document was varied, in an attempt to accommodate as many clinical examinations as possible. Practitioners however, were advised to include a minimum of three and a maximum of seven examination categories within their log book, and the ethos of the CT competencies framework focused around the developmental needs of the workforce and the emerging workflows of the organisation.

Following an initial review of the CT competencies, feedback from a number of clinical sites indicated the need to include a section on additional quality control checks (figure 4), safety considerations (figure 5) and a revision to the range of clinical examination areas that may be included as part of the practitioners learning. The initial feedback was subsequently included within the revised CT competencies document.

Feedback from alpha site #1

'Overall, the feedback was positive. It was strongly felt that the competencies provided a clear pathway and direction for learning, and I felt that this allowed for a smooth training pathway and ensured that the technologist was focused on the learning outcome.

It was, however felt that the categories for examinations were geared towards a full diagnostic CT service that would not be appropriate for NM SPECT/CT that is mainly centred around localisation.

Nevertheless, I have found them to be a valuable tool and I hope to use the competencies for all in-house CT training.’

Of particular importance to the organisation, was the need for practitioners to understand at what level they would be using the CT component. Figure 6 demonstrates the potential levels of use for CT within a hybrid imaging environment. As the emerging workflow needs of a hybrid imaging department are being developed, it is crucial that the potential capabilities of the CT unit are fully understood. The authors advise repeat usage of the CT competencies framework as the evolving requirements of the CT unit are mapped within an organisation.

Subsequent feedback from clinical NHS departments has been generally positive and also highlighted further enhancements to the CT competency framework. It is acknowledged that the creation of the CT competencies framework is only one aspect of a potential suite of education and training needs for nuclear medicine practitioners. The notion of creating a new identity for practitioners working within hybrid imaging practice should be further explored by working with a range of professional bodies, along with members of the nuclear medicine community.

There is also a need for higher education institutes to ensure the relevant aspects of hybrid imaging practice are included in the curriculum. This would typically include scientific principles, technique optimisation, safe working practice, communication and patient care/psychology, quality control checks, image processing and storage and audit/service improvement process.

Example feedback from site #1

‘One of our technologists has completed the CT competencies that you gave me. The technologist in question has been signed off as competent to undertake localisation SPECT/CT as a result of using the framework..... Overall, the feedback was positive. It was strongly felt that the competencies provided a clear

pathway and direction for learning and I felt that this allowed for a smooth training pathway and ensured that the Technologist was focused on the learning outcome.’

Example feedback from alpha site #2

‘Thank you very much for your email and CT competencies for NM practitioners. On first reading it certainly seems very comprehensive and covers the key areas for training. I plan to get some of our senior CT personnel to have a look and perhaps (with permission) get two of our new NM members to go through it. I think the key issue is having the confidence and knowledge to be able to alter the CT scanning parameters, rather than just using the manufacturers default settings.’

Impact of introducing CT competencies within a nuclear medicine department – a case study

As in the wider nuclear medicine community, the workforce at Guy’s and St Thomas’ is of a varied background, including radiographers, science graduates with an interest in clinical work and technical staff who have undergone further training in nuclear medicine technology. With the advent of hybrid imaging systems in Guys’ and St Thomas’, radiographers generally undertook or directly supervised all SPECT/CT work, as they were considered to be the most appropriate operators of hybrid imaging equipment, due to their relevant core of knowledge.

With a single hybrid imaging unit that was initially underutilised in comparison to present day, this was feasible, despite the smaller proportion of radiographers within the technologist workforce. As the value of SPECT/CT became apparent, the utilisation of a single unit increased, as did the time demands on individual members of staff within the technologist team.

Furthermore, an informal



Figure 4: Quality control section of the CT Competencies document.



Figure 5: Communication and safety checks section of the CT Competencies document.



Figure 6: Range of use for CT within a hybrid imaging environment.

demarcation between the roles of nuclear medicine technologist relative to radiographer developed, which was both unintentional and undesirable. By having a CT competency framework available, we could plan robust training for individual members of staff, regardless of background, whilst being confident that operators had a specific set of skills and knowledge that allowed them to competently, effectively and safely undertake CT procedures as part of the overall nuclear medicine examination. This is essential given that older gamma cameras, as they are decommissioned, will generally be replaced by hybrid imaging units within departments, as has been the case at Guy's and St Thomas'.

The flexibility of the CT competency framework has ensured that the overall skill mix of the technologist workforce has increased whilst also providing a pathway for technologists to further develop skills associated with CT imaging as part of an advanced practitioner role, further enhancing the delivery of our service. This has also created greater collegiate working between technologists and radiographers within the nuclear medicine department at Guy's and St Thomas'.

Summary and future developments

It is appreciated that the subsequent production of any

competencies or guidance will not fit all professional domains or clinical departments. Rather, it is anticipated that individual nuclear medicine departments will adopt accountability for the local implementation for any new imaging protocols involving the use of CT, using a possible modular approach outlined in figure 6.

It is also important that the proposed CT competencies can only be used in an advisory dimension. The main focuses of the guidelines explored within this article, relate to the safe and appropriate use of CT within a hybrid imaging environment providing practitioners with guidelines that will benefit the management of patients.

In order to provide optimal patient-centred services and meet Government agendas (DH, 2010a), the need to ensure an appropriate skill mix within a modern nuclear medicine department is essential. Working in conjunction with professional organisations and leading clinical practitioners should enable the creation of appropriate guidelines and competencies to enrich the current and future workforce. It is anticipated that the CT competencies will be endorsed by the Society and College of Radiographers, through the Nuclear Medicine Advisory Group (NMAG) and become available to all members as a staff development tool.

How to use this article for CPD



1. If you are about to introduce CT within your nuclear medicine environment for the first time, consider the potential impact on workforce. What additional training requirements would be required, in terms of re-mapping the patient workflow and also the safe and competent use of an x-ray source?

2. If you have recently installed a SPECT/CT system within your nuclear medicine department, how do you ensure your CT acquisition and processing parameters are optimised for the various clinical examinations that may be undertaken?

3. What consideration could you give to potentially further reducing the radiation dose associated with CT when used as part of a localisation/diagnostic registration hybrid imaging examination?

About the Authors

Marc Griffiths¹, Damion Bailey², Fiona Matthews³, Gary Dawson⁴

1. Dr Marc Griffiths: Head of Department, Allied Health Professions, Faculty of Health and Applied Sciences, University of the West of England, Bristol.

2. Damion Bailey: Clinical Tutor Nuclear Medicine, Guy's and St Thomas' Hospital NHS Foundation Trust, London.

3. Dr Fiona Matthews: Faculty CPD Lead, Faculty of Health and Applied Sciences, University of the West of England, Bristol.

4. Gary Dawson: Senior Lecturer and MSc Nuclear Medicine Programme Manager, Faculty of Health and Applied Sciences, University of the West of England, Bristol.

References for this article can be found at

<http://www.sor.org//learning/library-publications/itp>

This article has been prepared following local guidance relating to the use of patient data and medical images.

To comment on this article, please write to editorial@itpmagazine.co.uk